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Universal sound card interface for digital modes

Nowadays it's scarcely possible to imagine a radio amateurs shack without a PC. Moreover it can be used for digital modes such as FAX, RTTY, WSJT, packet radio or CW. So for some time now modern applications have also favoured the sound card as the interface between the PC and the radio apparatus. The universal sound card interface for digital modes presented here is an isolated low frequency interface using opto-couplers and transformers for level matching requiring only a 12V supply.

1. Introduction

Modern PC sound cards, including their operating software, are efficient in that they have no difficulty in mastering the digital modes which are common in amateur radio, such as FAX, RTTY, WSJT, etc, for both transmission and reception. Good user software exists, with elegant user interfaces, for the interested radio amateur.

The universal sound card interface is isolated for transmission and reception, using low frequency transformers and opto-couplers. The control signals (for PTT and CW) can be optionally implemented through the serial interface

COM1 or COM2.

It can happen that these COM interfaces are no longer available as a standard feature on modern laptops. These functions can be derived from the low frequency signals of the sound card using a system similar to VOX. The universal sound card interface also provides for this option.

2. Circuit description

The circuit for the sound card interface can be seen in Fig. 2. The sound card interface is controlled through the "Line-In" and "Line-Out" connections of the PC's sound card. In addition, the PTT changeover and the "Key" connection for CW signals use a serial interface on the PC, for example COM1. Alternatively, the sound card interface provides a VOX mode option. The control signal for CW can be obtained from the low frequency output signal.

Both low frequency signal paths are isolated using low frequency transformers; this avoids the possibility of leakage pickups.

The reception path, i.e. the loudspeaker output from the transceiver to the "Line-In" connection of the sound card, is also

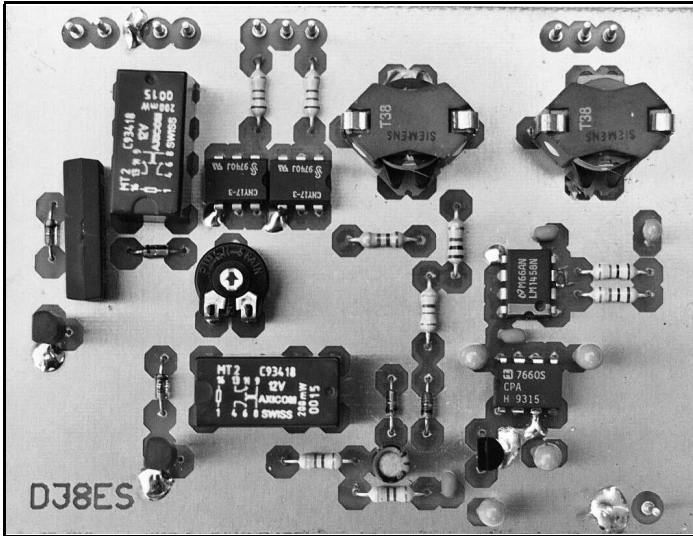


Fig 1: Completed universal sound card interface.

equipped with an LM1458N (IC3a) operational amplifier. With the given circuit resistance values, the amplification obtained with $V=R_4/R_5$ is $V=1$. If necessary, this value can easily be matched to the given circumstances. At the same time, this amplifier (IC3a) gives a high value input impedance, which can be used to connect the input in parallel with the loudspeaker in the transceiver. In practical operation, "overhearing" a continuous but faint received signal has been found to be generally practical.

A normal 13.8V supply voltage is used. The plus/minus voltage ($\pm 5V$) required internally for the operational amplifier is obtained using a 78L05 fixed voltage regulator (IC4) and an ICL7660 voltage inverter (IC5). This requires only minimal external circuitry using tantalum electrolytic capacitors.

In the transmit path, a relatively low level voltage is required for the microphone input of the transceiver. This is adjusted to the required value after the transformer (TR2) using the adjustable R2/R3 voltage divider.

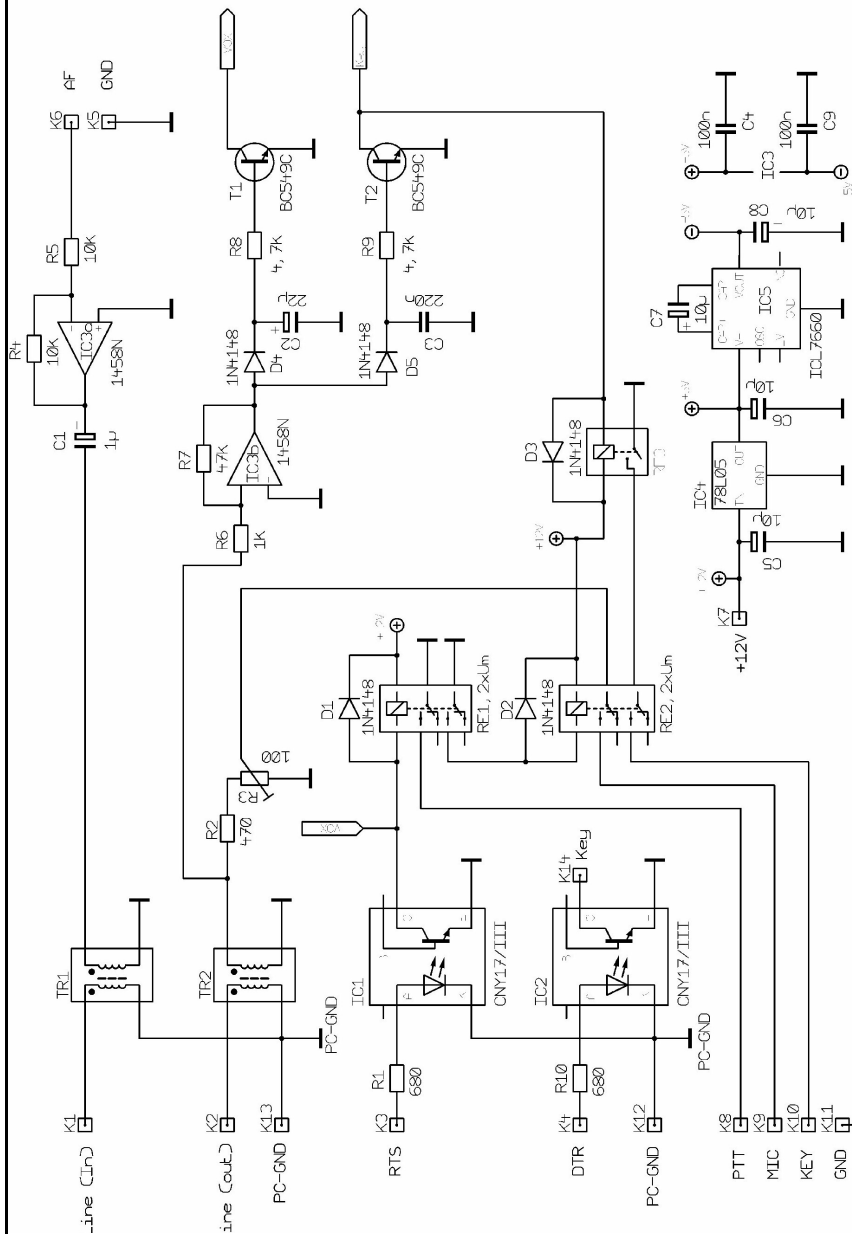
The signal from the low frequency transformer (TR2) is taken off in parallel and fed to an LM1458N operational amplifier

(IC3b). As a minimum, its amplification must be sufficient for the two subsequent rectifiers (D4, D5) and the T1 and T2 switching stages (BC549C). The amplification is fixed by means of the resistances, R6 and R7; the value selected here was: $V = R_7/R_6 = 47$.

The two capacitors, C2 and C3, should be calculated in such a way that they give an adequate time constant for the VOX control for CW. Their values are calculated as 22 μ F and 220nF.

The switching stages are relay RE1 for the PTT and the Reed relay RE3 for CW. In addition to the PTT of the connected transceiver, the signal activates an additional internal relay, RE2. This switches both the low frequency and the CW signal to the transceiver. This automatically triggers a sequencer function. As is usual with this type of control, the transmitter is switched on first, and only then the modulation!

The option for the VOX mode just described and this type of CW is optional. Normally these functions are controlled through the serial interface of the PC. Here the signal RTS (Ready to Send) for PTT and the signal DTR (Data Terminal Ready) for the CW key. In this



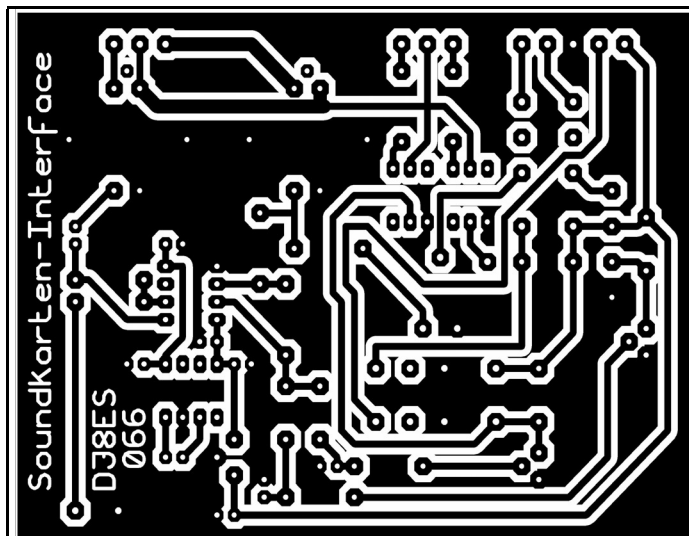


Fig 3: Track side of PCB for universal sound card interface. Board dimensions are 75mm x 100mm.

case, the two switching stages (T1, T2) are superfluous and should not be fitted. The K14 connection (Key) is connected to the collector contact of T2 by means of a jumper.

For isolation (and to protect the serial interface of the PC!) both the signals are fed through CNY17/III opto-couplers (IC1 and IC2). This gives complete potential isolation between the PC and the radio equipment.

3. Assembly instructions

The sound card interface circuit for digital modes is mounted on a 75mm x 100mm double sided copper coated epoxy printed circuit board (Figs. 3 and 4).

The specimen unit was mounted in a standard aluminium housing. All connections are fed to the rear face of the assembly.

Following the drilling of the circuit board with a 0.8mm or 1mm drill e.g. for terminal pins the components are fitted in

no particular order, in accordance with the components drawing (Fig. 5).

At this point, see the corresponding passage in the circuit description above with regard to the optional VOX function (including CW).

4. Parts list

IC1,IC2	CNY17/III, Opto-coupler
IC3	LM1458N, Operational amplifier
IC4	78L05, Voltage regulator
IC5	ICL7660, Voltage inverter
T1,T2	BC549C
D1-D5	1N4148
TR1,TR2	Low frequency transformer, Siemens
RE1,RE2	Relay 2xUm
RE3	Reed relay, 1 x On
R3	Trimming potentiometer 100Ω, horizontal, RM5/10mm
C1	1nF/16V, RM 2.5, tantalum
C2	22nF/16V, RM 2.5 tantalum
C3	220nF, RM 2.5, ceramic

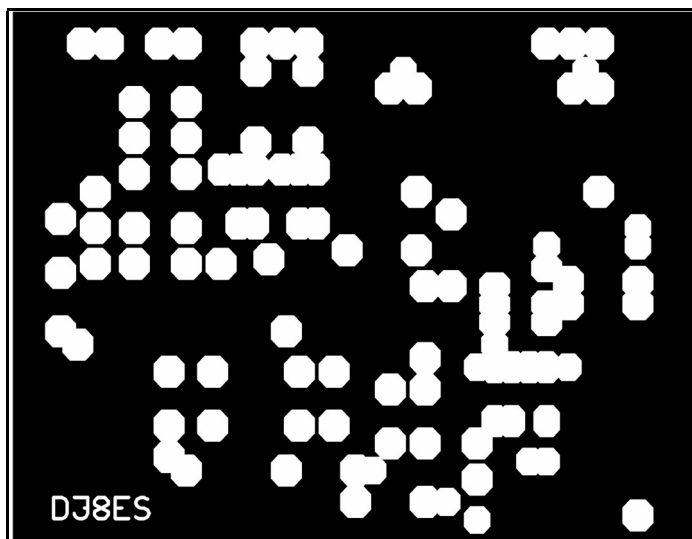


Fig 4: Copper side of PCB for universal sound card interface.

C4,C9 100nF, RM 2.5, ceramic
C5-C8 10nF/16V, RM 2.5, tantalum

1 x PCB DJ8ES-066
14 x Terminal pin 1 mm

Carbon resistors, 1/4 W, RM 10mm:

R1,R10 680Ω
R2 470Ω
R3 100Ω
R4,R5 10kΩ
R6 1kΩ
R7 47kΩ
R8,R9 4.7kΩ

5.

Putting into operation and calibration

The sound card interface is put into operation for the first time, following a visual check of the circuit board. For the standard operating voltage in amateur radio of +13.8V, the current consumption of the assembly is approximately 6mA, and up to 40mA if the relay is wired up.

The interface is connected to the sound card connections "Line-In" and "Line-

Out" on the PC. The PTT changeover and CW are detected on the PC side in the normal way by a serial interface (e.g. COM1). An alternative option here is to generate the control signals from the sound card low frequency (cf. circuit description).

On modern transceivers, with the exception of the CW key connection, all other necessary signals or voltages (Mic In, low frequency out, PTT and +13.8 V) are fed through the microphone socket on the front face of the apparatus. The manual for the individual transceiver can provide assistance here with regard to the pin layout and the level adjustment required.

The low frequency level for both the microphone (on Line-Out) and the low frequency output of the transceiver (on Line-In) are set by the software required for the individual mode. Should this variation range, not suffice, then the series resistances can be changed in the universal sound card interface circuit for example, resistances R4/R5 for the low frequency output. The given values cover numerous contemporary transceivers. The microphone level is pre-set using the R3 trimming potentiometer.

At this point, perhaps we may also be

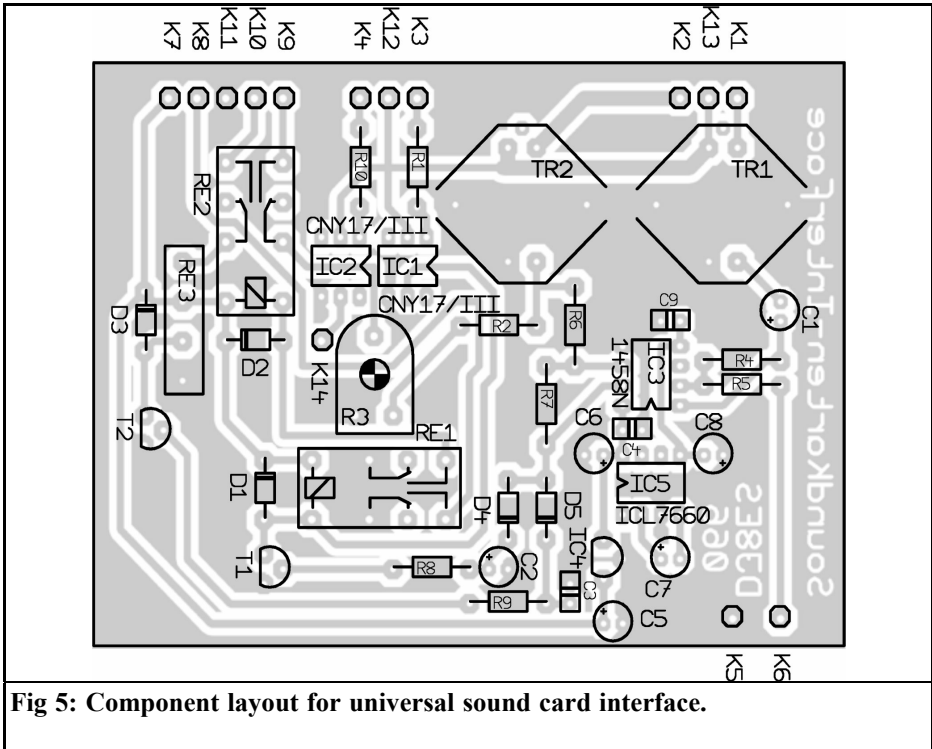


Fig 5: Component layout for universal sound card interface.

allowed to refer to the correct adjustment of the microphone. Saturation considerably impairs the modulation quality and also produces bandwidth that is not needed. Unfortunately, it is in narrow band applications such as, for example, PSK31 that this effect is more and more evident.

cards and their use in the radio amateurs PC (2); *Funkamateur* 06/00, P. 614

[3] Ing. Klaus Raban, DG2XK: Sound cards and their use in the radio amateurs PC (3); *Funkamateur* 07/00, P. 734

6.

Literature references

[1] Kurt Kuhn, DL 4 VAB: SSTV/PSK31 Interface for DF0SAR cq VFDB 3/2001, P. 19

[2] Dr. Reinhard Krause-Rehberg, DF5RK: MFSK16 A new digital mode for sound cards, *Funkamateur* 06/01, P. 610

[3] Ing. Klaus Raban, DG2XK: Sound